# CS7643: Deep Learning
# Fall 2017
# HW0 Solutions

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February 22, 2020

## 1 Probability and Statistics

1. No.

$$\begin{aligned}\mathbb{E}[x] &= \sum_x x * p(x) \\ &= 1 * 1/6 + \sum_2^6 (-1/4) * 1/6 \\ &= 1/6 - 5/6 \\ &= -4/6\end{aligned}$$

2. The corresponding distributive function is

$$\begin{cases} \int_0^x 4x dx = 2x^2\Big|_0^x & 0 \le x \le 1/2 \\ \frac{1}{2} + \int_{\frac{1}{2}}^x -4x + 4dx = \frac{1}{2} + -2x^2 + 4x\Big|_{\frac{1}{2}}^x & \frac{1}{2} \le x \le 1 \\ 1 & 1 \le x \end{cases}$$

3.

$$\begin{aligned}\mathbb{E}[x - \mathbb{E}[x]]^2 &= \mathbb{E}[x^2 - 2x\,\mathbb{E}[x] + \mathbb{E}[x]^2] \\ &= \mathbb{E}[x^2] - 2\,\mathbb{E}[x]\,\mathbb{E}[x] + \mathbb{E}[x]^2 \\ &= \mathbb{E}[x^2] - 2\,\mathbb{E}[x]^2 + \mathbb{E}[x]^2 \\ &= \mathbb{E}[x^2] - \mathbb{E}[x]^2\end{aligned}$$

4.

$$\begin{aligned}\int_{-\infty}^{\infty} p(x)(ax2 + bx + c)dx &= \mathbb{E}[(ax2 + bx + c)] \\ &= a\,\mathbb{E}[x^2] + b\,\mathbb{E}[x] + c \\ &= a * (Var(x) - \mathbb{E}[x]^2) + b * 0 + c \\ &= a * (1 - 0) + 0 + c \\ &= a + c\end{aligned}$$

## 2